MAIN CURRENTS

IN MODERN THOUGHT

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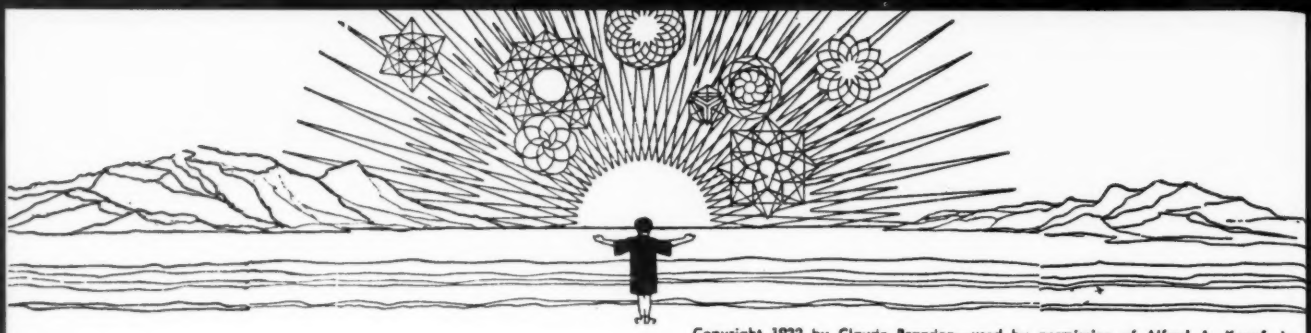

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MAIN CURRENTS IN MODERN THOUGHT

A cooperative journal to promote the free association of those working toward the integration of all knowledge through the study of the whole of things, Nature, Man, and Society, assuming the universe to be one, dependable, intelligible, harmonious.

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On the cover: Astrolabe, Arabian (?), late 13th century (695 A.H., 1296 A.D.). Courtesy of the Metropolitan Museum of Art, bequest of Edward C. Moore, 1891.

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THE ENTELECHY OF TIME

Anderson Nettleship

A Consideration of Protoplasm as a Time-Binding Stream

EVIDENCE presently accumulated points towards the universe as an entirety, of which man is a corporate part. In this emergent view, one of the chief problems is the meaning of time. Time as a realization or actuality, or projected as a mere sensibility of duration of events, or even as nonexistent, as against its reality as a fourth dimension—each of these aspects has been thought of as the main feature of time. Man has devised many descriptive words: absolute-time, mean-solar time, apparent-solar time, standard-time, sidereal time, biological time; the equation of time being the difference between apparent time, sundial or earth rotation and mean time, the standard clock. One can only wonder if man would have any time sense if he had not evolved in a cyclic environment. This aspect makes for two views, namely, time as cyclic or time as rectilinear. For while man has the capacity to view space in the universe directly and thereby gain a concept of structure, time can be regarded from a variety of sources, and man's view of this phenomenon, in spite of practical measurements, remains startingly animistic.

A more sophisticated view that time is merely a fourth dimension of space fails to escape the fundamental consideration that time is a human concept, based upon sensorial data, which recognizes repetition of experience. The most accurate time measuring device is the oscillating quartz crystal. The mechanical clock is a complicated machine, of difficult theory, and man-made to imitate the earth's rotation.

There is much confusion between occurrence of physical events and the idea of time. This is particularly true in the biological field, where the unfortunate term biologic-time has been used to characterize happenings within the cell, as well as the ageing process. In our present phase of data-gathering the best to be hoped for is simple descriptive terms rather than classification or mathematical characterization. Time can only be considered through a human view.

In the light of recent cosmic-scale space exploration by astronomy and of the microstate level by the quantum theory, time seems to be characterized by the same category of phenomena as space, namely as a realization both of the instant and of aeons, both predictable and unpredictable, both comprehensible and incomprehensible. With or without commitment to causality, in an integrated view, time occupies a place in metaphysics as well as in nature.

From the earliest ages the human mind has struggled with the problem. In India the idea of cosmic cycles combined with the idea of dissolution and renewal developed; a single cycle was said to last 4,320,000 years. Interestingly, mythology treats of time as a good or bad thing. To the primitive the world is periodically created and destroyed, the lunar symbolism of birth, death and rebirth; the Phoenix rises from the ashes of its nest. This close connection between time and life and death makes it mandatory for man to attempt to control the process; he can do this by ritual, by return to pristine time through myth; by trying to escape or to abolish time. Each of these has a technique whereby it is to be accomplished.

In further attempts to relate daily happenings to time, man found causal connections not only in numbers to measure it, but in synchronistic phenomena as well. Thus events which occurred simultaneously or nearly so, in time, must, in this view, have causal connection.

As man attempts to seize upon visible phenomena, he uses plastic means of representing his thinking. But he also uses the invisible spirit, *Time,* whose passage he marks by day and by night, by the seasons and the stars. In the latter effort he had to devise symbols, and thus cosmologies were born, each of which touches the soul of its culture of origin. For the Egyptian this image was permanence, for the Christian transfiguration, for the Greek humanism, for the Aztec and Mayan the human body used as a terror sacrifice. The value of ceremonial to appease time is either playful or, more often, grim. Aztec cosmology's eucharistic concept of man's relationship to time was that of appeasing the gods responsible for the continuation of the vital rhythm of life through the act of human sacrifice.

Aristotle formulated the problem very well: "Time is, if not motion, at least something in it; it is the number of motion, hence an event and a state of motion." Yet perhaps we should never have come clearly upon our relationship to this problem had it not been for evolutionary theory. Although Wallace and Darwin had no real view of the vast reaches of

time in which life has existed, they were able, no doubt due to the diversity of living forms, to provide a satisfactory theory of evolution. Standing in a moment of time, swept by an overwhelming historical sense, Darwin elaborated the master scheme which goes far to explain both past and present forms of life—perhaps even provides a scaffold upon which to predict the future. In this view, man is a part of nature and of time-spanning aeons, whose being is more than the accumulation of all individuals who have lived in the past. The evolutionary process can only take place in a continuum of time. The time element has proven difficult to relate to organic evolution since evolutionary processes are slow, and our experimental time in which to try and prove the processes is so brief.

Regardless of the need for proof, evolution can only be expressed in terms of time and change, and in this our greatest recent aid is the discovery that organic-archeological time can be measured by radioactive techniques. The morphology of evolution is, of course, time set in organic terms of relative, but amazingly brief, stability.

The Bergsonian view that lived time is real time may be accepted.

ABSOLUTE time as described by Newton flows at a constant rate; it is not affected by either events or material objects. I find no objection to this view; in fact I can conceive of no other. Time is described as a fundamental physical quality. This may not be a fact—it is more of a subjective process, since man's mind interprets the reality of physical events in orderly manner through the idea of time. I cannot escape the sense of absolute time, which I feel sure is not dependent on the sensory organs. On the other hand the physiologic changes within my body may dictate this sense, and I must in theory state that universal or cosmic progressions of events could take place in a timeless sense, even though they followed each other in subsequent or cyclic relationship.

We are incapable of thinking about the cosmos or evolution except in terms of happenings which took place millenia ago. Thus, we rule out the term time but understand the passage from then until now.

Prior to the present era, there was insufficient data, both physical and biological, to arrive at a comprehensive view of time. We have also been bound by religion and tradition, which attempt to put life situations into formal dimensions without first discovering the facts about time and evaluating these biologically. Because of this, much confusion results. Each facet of life finds its expression and changes with time. But change in time does not order time. While it is readily possible to visualize spacial relations, man has no comparable equipment for perception of time. Time passes and man "senses" this passing, but the sensing is based upon an elaborate synthesis of data derived from many sources.

Time's awareness is a part of man. Would time exist without man? Is not the concept of time strictly a human one? The events of eternity which range throughout the universe show an orderliness. It is from these things that man rationalized a concept of time. Man has personalized this matter until he defies death and demands immortality. Only man with his historical consciousness would be so foolish as to seek self-physical immortality. Time as such is merely change without possible reference to any human activity. The human Gestalt of time is brought about because biologic and universal processes have a coming and going. There is a rhythm in life. Because he is conscious of this, man has devised many sorts of time, none of them objective. Orderliness, whether it be the "pulsating" of the universe or the micro-measurement of the sodium line, speaks of universality of time as being subjected to natural occurring processes. The most precise clock imaginable to man speaks of a cosmic power which binds the universe together.

Time is perhaps of itself the strangest of all paradoxes, for it is not a thing which can be put to the test of a sensorium but is, once its qualities are understood, a concept without which there can be no comprehension of reality. Thus time defies being weighted, measured, tasted, felt or seen, yet by a combination of his senses, transmitted memory, and a developed historical sense man gains some insight into its meaning. Time then, fugitive and elusive though it be, becomes the binding cord of the cosmos, placing man in a today which is derived from yesterday and yet speaks of the future. From all this, time becomes measurable and related to all physical things, for in it origins, birth, growth, senescence and death take place. We cannot precisely measure two intervals of time and compare them with each other, for the second interval, when defined, must follow the first; we can compare, however, their measurement through a mechanical device.

What it is that gives man a sense of absolute time, as flowing at a constant rate (Newton), is wholly unknown. Perhaps man, as a sensitive indicator of universal processes, can from the nature of his origins and the rhythm of events, ascertain the broader meaning of absolute time as a flow process.

It is a hopeful thing that ill-equipped for this purpose as man is he can still begin to analyze the meaning of time. With modern advances in the scientific view of nature, the meaning of time in its relationship to human beings begins to have new and fruitful ramifications.

LET us consider this from three viewpoints:

(1) The viewpoint of physics in quantum mechanics and relativity,

(2) The viewpoint of paleo-astronomy,

(3) The biological viewpoint.

As to the first, quantum and relativity theory lock time into space as a fourth dimension, and hold that it is possible to control time's passage through the

device of increased rate of travel. Actually if the macrostate, as measured by an alteration in a mechanical clock's rate, does change, this does not mean a change in absolute time. Through the "reciprocity law," time reversal is said to occur, something unknown and unproven on the macrostatic level.

The view of time which has emerged from the combined studies of paleo-archeology and astronomy is that the universe dates back in origin about five billion years. The combined evidence, from radioactive studies on rocks and from astronomical events, seems irrefutable. Furthermore, radioactive and other studies on carbonaceous materials date the starting of life on earth, in an organic sense, at 500 to 1000 million years. These new views of nature give man a wholly new sense of the relationship of the biological to the universal.

The biologic view of time can have no validity unless it is coordinated with the other two views of reality, and herein is contained a double daemon. First, all information about the universe is sensorially, i.e., biologically, derived and hence is rigidly limited by this factor. Second, biological processes are inherently altered by and through the passage of time. The first aspect has been considered in our introductory remarks about time as a subjectively and organically conditioned issue. We shall now consider the second feature, the intrinsic and intimate relationship of all time to biologic matter.

If organic life "started" half-a-billion years ago, regardless of its exact origin, it must have begun through a method related to the time process. That is, the universe had already existed for three-and-one-half or four billion years. Further, life must have started in relation to the cyclic events which were taking place in the universe and on the earth at that time, including the rotation of the earth, the passage of day and night, the circumambulation of the moon about the earth and the earth around the sun; the seasons, the collection of moisture, carbon-dioxide and oxygen, the erratic spray of cosmic rays, the great universal pulse of the solar system, as well as the little atomic pulse of the earth as shown by energy particles interplaying on sub-atomic and atomic levels. These pulses, acting irregularly and in rhythm, became manifest in time and formed molecular entities. Thus erratically, organic and biological entities came into being upon the earth in time and have been unabsolved from time ever since.

ONE of the most profound and elusive problems which has faced mankind is that of cyclic time, for while the cycles of the days and seasons, birth, growth and death make man aware of events taking place in time, the problem of whether a repeated or sequential event is really a passage of time has never been solved. The problem of time has received renewed interest through recent discoveries in both biological and astronomical fields.

But new knowledge, unless integrated with the old, can be destructive. Our deepening concepts of the cosmos and man lead us to a more equitable understanding of ourselves and our place in the whole of things. Man can behold himself now in proper perspective, not as a stranger who must build a myth around himself to protect his tender life from the adversity of environment and the cruelty of time. Man's greatest feats of imagination always fall so far short of the grandeur of reality! For man is truly a part of nature and can enjoy not only the heights but the depths of time as well. Natural science is no threat to the fundamental life experience, but rather a confirmation and extension of fundamental archaic beliefs which spring most directly from the center of nature. Such pseudo-sciences as deviate from Darwinism fail to explain preservation of the species as the final goal of evolution. Man far exceeds his mere animal nature.

THE importance of time, so far as the biologist is concerned, is this: growth and development are the moving parts of an energy system, oriented in and derived from historical time; the individual system involved is limited in time; the whole process is irreversible.

All biologic units live in the four dimensions of space and time. Our perception is such that we understand the visual tri-dimension more readily than we do time. We have been able to develop fairly accurate pictures of the morphology of man, but how these move in time is altogether another matter. We must clearly distinguish between the "normal" changing events which take place in the biologic unit, such as growth, birth and ageing, and time passage *per se*. While the former must take place in time, and undoubtedly are related to universal events such as moon phases, rotation of the earth, radio-activity, and cosmic radiations, biologic events are not of themselves a measure of time nor can they be reasonably used for this purpose. The reason for this is that "living," moving, functional, adaptive, biologic phenomena are altogether too irregular in their energy manifestations to be useful in this regard. Biologic processes are rapid reactions, measured in parts of a second, as well as astonishingly slow ones, such as evolutionary processes working through millenia; at any instant every feature of man as a living organism is exhibited in time as well as in space. There is a vast spread in the time during which biologic events occur, but there is much intermittency as well as progressions, regressions and cyclic changes. Physical characteristics, the chemistry of the body, sizes and relations of structure—all change with time. The ageing person retains the all-important life compound, nitrogen, for a shorter span than the young person. In the embryo and in youth, new processes and structures appear and grow at different *rates* unique to each period of life. This alone is a terrifying process which separates the members of each generation from one another.

All these aspects of time's relationship to the structure and function of the living body are of utmost importance in arriving at a complete concept of time and life. Spacial and time dimensions are of equal value in the living. At the moment of death, structure disintegrates and time disappears as a biologic element.

One of the least understood aspects of the relationship of time to biologic processes is the almost unbelievable differences in degrees. The spread of biologic action from 0.0001 second to hundreds of thousands or even millions of years escapes us. Man is equipped to understand small time values, but he cannot really grasp the meaning of the larger time units. While we, in theory, speak of millions of years, we have no tools with which to grasp this notion. Part of this handicap may reside in the inherent nature of living protoplasm, as contrasted to hereditary and to universal non-organic processes. Man's years are based on the earth's annual pilgrimage around the sun and its daily revolution, whereas in the modern view of the universe, time is measured in billions of years.

The biologic spacial problem is equally complex, ranging from living particles in the range of 0.0001 mm. to the massive size of the elephant, whale and giant redwood. All living things from virus to mastodon are whirled at unbelievable speeds through space in four different directions simultaneously and with great diversity in manifestation and rhythm.

THE whole theory of causality is based on time, since it depends upon antecedent events firmly embedded in time. In most such schemata, cause is temporally anterior to effect. Time is the factor which determines the relation which events have to each other; whether it be a physical object or the action of a physical object, time surrounds both. There is real comparison to be made between the same qualities which space and time reveal.

From the best evidence which we can gather, protoplasm is a unique and beautiful example of an ordered, open-ended, negative entropic process, functioning in time. The nature of this process, which we characterized as living, has inherent limitations both from its fragile nature and from its inherited features. The marvel is that such a delicate thing as life could exist at all, considering the conditions in most of the universe, and that once having defined itself, it has been able to survive so long.

If man could understand cosmic time, he would realize the transiency of the human species. He would also find out that such transiency, the cyclic closure of phenomena, is characteristic of *all* phenomena, whether it be the brief life of a bacillus or the near-eternal life of the rushing suns of the universe; each has a birth, growth, senescence and death. Thus understood, man could reconcile himself to his own ageing and comprehend better the disintegration of civilizations which characterizes our own era. To understand the timelessness of time gives man a security he has not hitherto possessed. It keeps him from becoming forlorn and alienated by personal or cultural disasters.

One can only look upon time itself as rectilinear regardless of how cyclic events may be. The same must be said for space. No amount of repetition of incidents can reverse time or bring us back to the identical place in space which we occupied an instant ago. While cyclic events assure the renewal and continuity of phenomena, the rectilinear and irreversible nature of time suggests a beginning and end. The totality of this concept is again beyond understanding.

We have always thought of ourselves first in our immediate period and only then historically. This is altogether too narrow a view, since it does not really place man either in evolutionary perspective or in the perspective of absolute time. Let us discuss these two latter considerations.

TO place ourselves in evolutionary perspective brings the admission that we are an integral part of the whole biologic process, beginning with the Cambrian and proceeding through the time of mammals up to the present. Hitherto the admission that we are no more, no less, than a part of the evolutionary process was nearly too much for us to tolerate. The fact gives a grip on a larger segment of time than most of us are willing to embrace—as much as 500 million years.

Take the other view, that of man placed in the perspective of absolute time. Here we become even more lost and humbled, for astronomic time speaks in billions of years. In this light how transpersonal and how inadequate man appears.

These two views of man in time are facts, not to be denied but to be lived with.

The major problem about life is how it is related to the rest of the cosmos. Its place in the broad spectrum of natural phenomena carries no question. Its possible uniqueness carries every question. In the broad sense life is related to all universal phenomena through time and space binding. But time is a short span as well as an eternity, and the property of a particle in one instant of exact time is never the same in the next instant of time, if for no other reason than that it has been changed by the second instant. Time and space become one. Neither has meaning or content without the other.

While man as an expression of nature fits his biological processes closely with seasonal and diurnal changes, and is to some extent controlled by them, he is also set free of them by inherited processes which tend to disregard cyclic seasonal variants. These and the interior functions are said to occur in "biological time," as if biologic process had a private time of its own.

Time, defined in the human sense as the experience of duration, is too narrow an idea. Cosmic events

certainly antedate life by millions of years, and absolute time will continue long after the bio-zone no longer exists on this earth. Life started at the beginning of the Cambrian period, variously dated from 500 to 1000 million years ago. How fascinating is the discovery that the organic building blocks, the amino acids of living proteins, in fossils which date back 150 to 300 million years are similar to the amino acids found in today's living organisms. The chemical pattern which was necessary to life then has persisted all of this time! Both the biospectrum of structure and its persistence are inescapable. There are even suggestions that life may go back a billion years.

WHAT interior sense makes us aware of time? Is it the conjunction of sensorial data, or is it independent of these? It may be a combination of internal mental control plus combined sensory data. If this is true, it should be possible to alter the sense greatly; this has been done by putting people in caves and depriving them of any physical time-measuring device. Such people tend to change their sense of time as well as their time-controlled habits.

We say, "Time is inherent in nature." But is it? Is it not rather that nature's processes make us aware of events, and that from this a "sense" of time is born? It is difficult, also, to conceive of a "time" memory, for while we may remember past events in the context of time, we cannot actually bring a past event into the present as we would by turning up a late clock. We should not, however, rule out the possibility of a kind of time memory on the semiconscious level similar to the proprioceptive sense memory shown by many animals in their ability to retraverse a maze once they have been through it. A live time memory, whatever its mechanism, should be accurate in placement and context.

Man and other living creatures are constructed in specific forms and have structure hereditarily transferred, starting at a particular time and place and ending at another time and place. Yet every living thing today contains molecular parts and patterns from those first constructed thousands of years ago. Thus life is a part of time; during its life an animal freezes time in a growing pattern which is lost only upon death. Biologic processes are marked and altered by physical time.

TIME is another feature of modern physics which has become involved not only with quantum physics but biology as well. The question of ageing at high speeds, arising from the so-called "clock paradox" of Einstein, has been the subject of heated debate. Scientists who have studied Einstein's theories carefully have no doubt that time is slowed when objects—whether men, clocks or atomic particles—travel with a speed close to that of light. This "time-clock paradox" has unfortunately been sometimes dismissed as of little consequence. Instead, it may be safely stated that if the same values of integration are obtained in the macrostate as in the microstate, the limits of life are soluble in terms of alteration of time. For if the clock paradox holds for man's life span, this can be increased at will merely by altering the rate at which man travels through the universe. If it does not hold, then protoplasmic rate of progression will remain unaltered by rate of speed, and even our concept of time will be unchanged by universal travel. One suspects that too close an application of the clock to biologic processes has been made, as though they were both simple mechanical devices—which is far from the facts.

Whether a fast-moving space traveler grows older more slowly than his stay-at-home twin is a biological problem, not one of time measurement. If growth and ageing are connected with high speeds, living processes can be modified almost at will by varying the velocity. However, everything known about protoplasm shows it is not possible to retard or reverse living processes, although this may be done temporarily under certain limited conditions.

Biological systems function in a manner different from atomic particles thus far tested for variations in life-span when moving quickly or slowly. Microstates cannot be inferred from macrostates, or vice versa. Erratic Brownian movements are not counterparted in the macroscopic world.

One suspects that the integrity of biologic processes is absolutely dependent upon earth environment, whether or not man takes his environment with him to the moon. All known biologic processes including ageing are earth conditioned, and a part of time. I can see no other view at this juncture, although as yet no experiments to prove it have been performed.

One can even go so far as to say that there is nothing in fundamental laws of motion to forbid time reversal. The repetition of a primary physical event has been confused with time reversal and the idea of biologic reversibility. Actually the repetition of the event must of necessity take place at a later time than did the primary event. Neither asymmetry of motion nor the cyclic nature of certain events guarantees either the asymmetry of time or of space, for in both instances time and space have moved on; the repeated event must necessarily take place in a new place and time.

Proof of the symmetry of the laws of motion and time in turn depends upon the so-called "reciprocity law," which states that the ratio of received energy to transmitted energy is always the same. This is merely a description of the energy which is acting to produce motion and, while this occurs in time, it cannot be said to "make" time reverse. *If* time could reverse it could conceivably go through this function; it could then possibly retrace itself through the realm of quantum mechanics.

To argue time reversal on the microscopic scale and not the macroscopic is like saying that microscopic acts do not reflect in the world as we see it;

yet all that we know argues for gross evidence of microscopic structure and function. The biologic world speaks for the view of time as rectilinear.

The enormous time consumed by evolution at once affirms the stability and toughness of biologic matter and belies the possibility of time-reversal in this process. Persistence of species and species progression speak against application of the time-paradox in evolution.

IT is necessary for man to have a deeply developed eschatological sense of time, for from this alone is he able to achieve sufficient insight to place himself in rational relationship to the cosmos. This view shows man what an extremely limited time he has existed in a universe where time values run so large; by this knowledge man has to live. Thus time becomes a deep human value, an article of faith that man's being has meaning in universal terms. What could be more ultimate than being related to historical time? What could be more profound than faith in such an extended future as that proposed by astronomers? Human beings, viewing the future history of biologic development in terms of millions of years, can devise fruitful plans not only for greater individual perfection but for better sociologic forms, wherein individual needs are combined with practical social orderliness. The worst thing which could happen at this juncture would be a return to a non-scientific view of reality. Greek thought conceived the cosmos as a thing "ordered and meaningful to human existence." This essentially scientific outlook has often been lost sight of. It should be restated in humanistic terms directed at still better environmental control, which includes atomic power sources.

Fundamentally unanswered is the question of man's place in limitless space-time. Man's life and death are of the same magnitude. Man should, for the first time in his history, occupy a strong time-space position from which he can reach forward with more insight, instead of the fear-ridden path from which he may, at any moment, fall into ignorance and superstition.

A definite space-time locus is the property of every object or event, but this is usually difficult to define. Nevertheless, unequivocal time determination is an absolute necessity for reality. The living energy system faces the same situation as a moving, individually self-circumscribed, but temporally near-immortal (one billion years) system.

The desire of man to remain at the center of his enquiry is perfectly reasonable. Life as we know it can have meaning for us only in human terms. Life serves as a locus of transient human time. It is essentially a paradox, for it must have meaning in universal as well as in human terms. The greatest problem of time is the instant destruction of the individual by death, while race and remaining bios persist. The word finite covers the short span of man's life, but life's characteristics are certainly suggestive of features found throughout the universe; it could not be otherwise, since life is a manifestation on earth of cosmic principles. Thus the human sphere, being part of the cosmic order, cannot detract from that order. Man's individual life is essentially an involvement with time on a circumscribed scale.

An important question is, do the rules of quantum mechanics and relativity apply to biologic as well as sub-atomic particles, or does living matter, though intrinsically conditioned by cyclic energy particles and events, have a different order of integration? We admit inescapable integration of protoplasm into archeologic and contemporary time. Further, the energy pool responsible for life is generally conditioned, as are all negative entropy complexes; it is orderly for a period, progresses through time, becomes disorderly and finally terminates. Thus it may be assumed that on the sub-atomic level the energy events which control life are subject to the rules of quantum mechanics and relativity. If these same rules apply to the macroscopic level, protoplasmic events in the human organism, including growth and ageing, can be controlled by increasing the rate of passage in space. Against this is the fact that even though man is travelling in space at a high rate, and living protoplasm at the equator is moving even faster than protoplasm nearer the poles, there has never been any report of difference in mitotic rates, longevity, birth rates or other notable features of living stuff in the two situations. Indeed, the greater the dependence of organic matter upon supra-atomic, i.e., molecular and cellular levels, for its energy sources, the more it appears that life energy follows its own organic pattern of integrated structure and activity.

LIFE is a phenomenon of dynamic ordered energy which relates discordant and unrelated things into a time sequence. The inner synthesis of structure and biologic compounds produces a living symbol whose synergistic configuration lies far beyond the separate parts—namely, the individual, man. In this whole scheme time is the essence; life's temporal component is expressed in terms of conception, growth, birth, maturation, ageing and death. And herein lies another of the unsolved problems. Does man grow old because, like a clock, his organism is wound up and must perforce run down, or does he grow old because of extensive environmental influences which adversely influence his internal living sphere? Is it a combination of both?

Finiteness is individual man, and this is his proper sphere. Extended to the whole universe, this makes its life a circumscribed event. Even though the longing for perpetual life is a human feeling, no such phenomenon of perpetuality can be found anywhere in the universe as described by modern science. The Greek concept of change echoes strongly today. Termination of the total organism in death is, then, an essential part of the life process. Physical dissolution of the organism should come as no surprise when it is known that physical units all the way from bacteria to galaxies undergo processes which include dissolu-

tion. The process of orderly energy gain and loss operates everywhere in the universe; which gains the upper hand results either in persistence or degradation of the structure of its energy-gaining potential.

The possibility of asymmetry of time in the microstate seems firm, but it may not be accurate for the macrostate, and hence the time-clock paradox may fail. And even if it is accurate with known mechanical devices, the order of integration of protoplasm may make it inapplicable to biological processes.

The meaning of time's content to man lies in his manifest destiny. He may deny all evidence of this in thought, or he may strive for and attain nearly pure action. Experience of the duration of time may be changed by conscious or unconscious processes. The sense of time is enlarged or stilled by mental activity; it is greatly altered by various chemical compounds, such as alcohol, opiates, hashish.

DOES the belief in time as herein presented remove from us the search for self? Far from it. Rather, it gives us the only logical center from which individual development can take place. After all, living man is but the moving tip of an energy process which started millions of years ago and extends forward in equal or longer duration, wherein an epoch is but scant time. Thus thrust back upon ourselves we find our greatest strength. Man, even as an accumulation of historic time, is a rather elegant creature. Envision him as the result of evolutionary and absolute time and he becomes a mighty fulfilment and possibly a mightier hope.

This is written from information presently at hand, but it does not mean that new facts cannot alter this view. As said before, we are in the early stages of our knowledge about time, and it may be that when much more is known the time-clock paradox may be applicable to man's life. There is only one way to find this out, and that is through careful and detailed observations, not only upon natural situations but also through experimentation.

Lest what I have said be considered fatalistic, let me hasten to say that I put no judgment values upon the facts so far ascertained. The reader may derive from them what he will. For myself, these facts encourage me to believe in man and in his ultimate destiny as a creative one.

We know that man survives because of his capacity to deal with environmental adversities. This oft-repeated, this millionth, billionth act of survival is entered into instantly and daily throughout our lives. Yet man can only continue to survive while personal well-being is sufficiently intact so that he can carry out these acts, both as an individual and as part of a group. It is because of this latter aspect that man's moral obligations originated. The necessity for group activity in this area enforces a moral definition upon man for his well-being and happiness. This concept as it originated in Greek Eudaemonism considered the idea of moral obligation in relationship to happiness or personal well-being. I prefer to consider it as originating in the natural processes of human survival.

Scientific method is of itself derived from the time characteristic of change. Every phenomenon changes in time, except perhaps time itself. Hence time as the basis for change makes all phenomena open to scientific study.

While most of our struggle is to adapt ourselves to environment, we also try to reach an understanding of our place in nature, in terms of the new data offered by science. Of course the above view does not deal in absolutes, but it should help us reevaluate our known situation in more explicit terms. In so doing, many fears and false myths fall by the wayside. Living man, instead of being the hub and center of all, is the moving flux of an energy process which is part of the whole grand show of the universe. Being thus a true part of, rather than extracted from, or contra to, nature, understanding the bio-limitations and rules, as it were, of our place in time and matter—instead of assuming unto ourselves a godlike aspect, we become that part of nature: man. This induces us to know ourselves as we truly are, not close to nature but rather *of* nature, moving in time for our brief span; being thus proud instead of ashamed of our real values, we can accept our place, as we find it, without fear, nor build a myth on death. For living energy, though circumscribed, can be changed but never destroyed, and while the individual biologic unit is expendable, the continuing process is not. Thus death becomes a fact to be accepted as part of the universal pattern of energy processes in time.

Time, nature's most elusive phenomenon, is her greatest means for binding all things together into a whole; yesterday, today, tomorrow fuse in a single inescapable necessity, absolutely beyond man's control. Or so it seemed until the discovery of asymmetry in elementary particles.

These new views must become part of man's belief, yet this is possible only if proper attention is paid to man's fundamental nature. The realness of this is the belief and love of myth. So proper science and the best understanding which man may obtain from nature becomes the greatest myth of all—the myth of nature as nature really is.

Thus the Greatest Myth derives its structure from a true scientific view of the universe and becomes embodiment and essence of the universe. From this canyon the depths of the human psyche rise, an indivisible unit enraptured, celebrating this epiphany of the only Truth.

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FIELDS IN PHYSICS AND BIOLOGY*

Henry Margenau

The Significances and Difficulties in Applied Field Theory

THE word *field,* which occurs so frequently in science today, is sometimes used rather loosely in contemporary literature, because it is subject to ambiguity and misinterpretation, Possibly one reason for this is that there are three types of fields in science. There are, first, fields of matter and fields in matter. These are concrete and perhaps the most easily understood. Then, second, there are certain fields which are associated with or in some way engendered by matter. They describe certain aspects of matter but are not material in themselves. And finally some branches of science are concerned with fields which are truly non-material, which have an independent existence of their own which may or may not affect matter in particular ways. Although these fields are basically defined in the same way, they do have special features which characterize them.

One book which highlights and endeavors to remove some of the difficulties and confusion which attend the use of the term fields is *The Evolution of Human Nature,* by the distinguished neuropsychologist, C. Judson Herrick. Dr. Herrick discusses fields which are known to most biologists, among them the concept of organizer fields developed by Spemann. Spemann was a biologist who, as a result of his experiments with living organisms, was able to show that there is a pattern to growth which can be described in qualitative fashion. It should especially be noted how the word *pattern* is emphasized: "The organizers of Spemann and the embryonic fields of biomechanics are defined in terms of the patterns of their action. The materials employed may be of diverse kinds at different places and times, but the pattern persists. So also if mentation is a vital process carried on in a field of metabolic activity, then the mind must not be regarded as an entity separable from its field of operation, a being which somehow pulls the strings that move a mechanical robot. The mind and the field are inseparably one. And the pattern of any particular mental act is not dependent upon the configuration of any stable structure. This pattern may come to expression wherever and whenever a suitable occasion arises, and it may operate by means of a different set-up of nervous connections on each occasion. The field in question is not a structure; it is a pattern of process. But such a pattern may occur only in some particular region of the brain with the requisite structural organization, and this region, which has more or less definite boundaries, may be called the field of this particular type of process, that is, a field defined in terms of its relations in space to other parts of the brain. The context will usually show which of these various meanings of the word 'field' is meant." (p. 266)

This example is rather typical of much that is to be found in the literature of psychology, biology, and to some extent, of physics. Such discussion has a great many interesting facets and points in directions that possibly could be made fruitful by further inquiry. But to make its uses really meaningful, the terms need to be much more precise. The only practical way to do this, it seems to me, is to go back to those areas of science where fields have been clearly and precisely formulated and where workable and successful notions are already at hand. With this in mind, then, let us turn our attention to the three kinds of fields enumerated above: First material fields, then fields associated with matter, and finally non-material fields.

MATERIAL fields fall into three classes. There is, first, the kind exemplified by the hydrodynamic field, which describes the state of motion of a fluid, that is to say, of a gas, or a liquid. If we think of a gas moving through a series of pipes, at every point within the volume permeated by the liquid there will be a pressure and also a velocity of the moving particles. This is all we need to know in order to describe the structure of the moving fluid. P, the pressure of the fluid, depends on two variables: the position of the point at which the pressure is to be observed or measured, and the time. This simply means that if the fluid is watched at a certain point, the pressure may have a certain value, but it may change in time. In addition to P we have another variable, the velocity of flow, and this again is a function of the place in question and of the time.

At this point there arises another distinction be-

* Revised, with permission, from a lecture given at the New School, April 15, 1958, as part of a course entitled The Realm of the Atom.

tween fields: Some are called scalar, and others are called vector fields. A scalar is a quantity which, in simple terms, has magnitude but no direction. Pressure is scaler because it is the same in all directions. Mass is scalar; volume is scalar; energies are scalar. On the other hand, there are directed quantities, such as force, about which it is useless to know the velocity unless the direction in which the movement takes place is also known. Therefore in science fields are distinguished from the point of view of whether the quantities in question are scalars or vectors. If the pressure is known at any point of space and at every instant of time, the field is fully described. In addition, the dynamic process through which the field operates will also be known. But if nothing more than purely descriptive information about the field were at hand, it would be impossible to make predictions. These become possible only when a *law* is stated which combines all the variables, usually in differential form. Therefore, in order to forecast what will happen within the material field of hydrodynamics at all accurately, one must first know the field quantities (e.g. pressure), and secondly be able to invoke a law—in this case, Euler's law—which regulates the behavior of these quantities in space and time. For example, if the pressure at one point is changed, the law indicates the results with respect to pressure and velocity in the fluid at all other points.

The stress-strain field is another material one which can be easily visualized. An elastic body, such as a block of steel, or a piece of jelly, can be deformed—the former with difficulty, the latter with ease. If a pull is exerted against the block, stresses will be set up within the material of which it is composed—the steel or jelly. The stress is the force which holds the particles together. The strain is the actual displacement which the molecules of the steel have undergone. Stress and strain are therefore the two quantities which make up the field: the stress a force inside, the strain a deformation. Stresses and strains may be scalars or vectors, depending upon whether the substance is or is not isotropic. If they are given, the structure of the field will be known, but it would not be possible to control or predict its behavior in any way without reference to the appropriate law—in this case, Hooke's Law of Elasticity.

A third type of material field is exemplified by the density field in the atmosphere. As one rises in the atmosphere, the pressure is steadily reduced. The pressure of the atmosphere therefore depends on the height at which it is measured. Only one field quantity is present, and that follows a certain law called the Barometer Formula, by means of which the behavior of the field quantity is determined.

WE now come to fields which are associated with matter. One example of this kind is the electrostatic field, perhaps the simplest non-material field and one which is of great utility. The field quantity in this case is called field strength. The difference between this and the quantities previously considered, such as velocity, lies in the fact that whereas velocity is a tangible thing and may be visualized, field strength is entirely abstract. If there are two objects which are electrically charged and one of them is brought into the neighborhood of the other, it will either be attracted or repelled, depending upon the sign of the charges. At certain points the force will be in one direction, and at other points it will be in another. Suppose, then, that in considering the disposition of charged bodies in a room, we want to determine the field strength at some specified point. The manner in which this is done is as follows: We select a test body which has a small electric charge on it. This test body is placed at the point in question, and the force which will act upon it as a result of the distribution of charges in the neighborhood is determined. That force can be measured in dynes or in pounds, and if it is divided by the charge on the test body, we obtain the field strength E, which is the latent force at a point—the force which would act upon a body carrying a unit of electrical charge placed at that point. Although this field strength may be said to be in a certain sense fictitious, nevertheless, it is something which we can measure. It is non-material —simply a "potential" force at any point in the field which will come into play when a charged body is put at the point. Such an electrostatic field is typical of the fields associated with matter. For if there were no charged objects (matter) present, there would be no field strength E, and no electrostatic field. The field itself is not made of matter. It is not even made of energy, although this is a popular misconception. There is energy *inherent* in this field, to be sure, but the quantity E is not energy or a force; it is rather a force per units of charge.

The magnetostatic field can be defined in similar fashion. The space around a bar magnet appears no different from any other, yet if a second magnet approaches the first it will be attracted or repelled. Such a magnetic field is defined like the electrostatic. The magnetic field strength is the force which would act on the pole of a small magnet (the force per unit pole), if it were placed at the point in question. Similarly to the electrostatic field, the magnetic field is something non-material which is generated by matter and would not exist without the matter (magnets) within it.

The gravitational field is another case in point. By virtue of the sun's mass, the surrounding region causes other masses to be attracted to it. It is matter —the sun—which is the field-producing mass. A planet in the neighborhood of the sun will be attracted to it and if it moves, it will follow in an orbit about the sun. This is because at every point in the space surrounding the sun there exists a field. The field strength—again in this case a vector—is defined as

the force which would act on a mass of one unit placed at the point in question. If all the values of this vector are known throughout space, the gravitational field has been fully described.

To repeat, such a field is not material, nor is it made of matter or energy. Yet if we put something with mass into its space, it will be affected; it will be attracted toward the sun. Because of that effect, which is not in evidence but can be put into evidence by visible means, we may speak of the presence of the field.

These three fields associated with matter have another peculiar quality. We know that the first and second are propagated with a definite speed. The field strength which emanates from a charge travels away from that charge with the velocity of light. The same thing is true of the magnetic field. We do not know, however, the velocity with which gravitational effects travel. By analogy, one would reason that the gravitational field should also be propagated with a certain speed. If this were true, there should exist in nature gravitational waves, but these have not been observed. Hence there is a strange and as yet unresolved anomaly in the dissymmetry between the first two types of non-material fields associated with matter and the last. Gravitational fields have another peculiarity quite apart from the similarity of mathematical structure. Electrostatic and magnetostatic fields can be positive and negative, repulsive as well as attractive. But no one has yet discovered repulsive gravitational fields; they seem always to be attractive. For centuries people have speculated why this should be—why two fields should have a dual action and the third an attractive force only.

Some light has been shed on this problem recently through the discovery of anti-matter. In normal matter the atoms are all made up of a positive nucleus and a negative charge of electrons surrounding it. It has now been discovered that for every particle there is also an anti-particle: for the positive proton there exists a negative proton, for the negative electron there exists the positive electron. The symmetry with respect to these ultimate particles of nature seems to be complete. The reason why all gravitational fields we have thus far observed are attractive may be that in the neighborhood of our galaxy all matter is of the variety with positive nucleus, negative electron. It is conceivable that at points far remote in space atoms may be constructed in another way, with negative nuclei and positive electrons. If this were the case, the collision of an anti-atom with a normal atom would cause a terrific explosion, and the entire mass would be converted into energy. According to this speculative hypothesis, if a piece of anti-matter could be made to combine with a piece of matter, the conversion of energy would be one hundred per cent efficient, whereas in the present nuclear explosions it is less than one per cent efficient. Perhaps fortunately, we have not as yet discovered anti-matter except in the laboratory. However, the conjecture is that it may exist in distant galaxies, and that the anti-atoms, so long as they are some distance apart, repel one another. That may be the reason why familiar matter is congregated in our part of the universe. Here is a conjecture which, if true, would restore complete parallelism among all three fields.

Physically, these fields associated with matter do not have much in common apart from some formal features. The electric field strength is a wholly different thing from magnetostatic field strength. Gravitational field strength again is quite different from sound and light intensity. Each field does involve energy, but it should be reiterated that this is not tantamount to saying every field *is* energy. Nearly everything in the universe has energy, of course; this is an undiscriminating fact in nature. It takes work to set up every kind of field that has been mentioned, and since work is energy, to that degree energy resides within the field. But only to that degree.

THE third kind of field, that which is entirely independent and wholly dissociated from matter, is in many ways the most interesting of all.

The first example of this type is the electromagnetic field, which is an extension, a generalization, of the electric and the magnetic fields previously considered. There are many kinds of fields that fall under this heading, such as the light-wave field, the radio field, the radar field, and the noxious fields set up by nuclear explosions. Every field which falls into this category belongs to the electromagnetic spectrum. As a class it displays two kinds of field strength, commonly designated as E and H, functions of both space and time. For example, within any ordinary room these two very definite physical quantities are always present, and are not dependent on the presence of matter within the room. An electromagnetic field exists outside material objects in the sphere of celestial space. Inter-galactic space is pervaded by electromagnetic fields although there is perhaps no matter there at all. Such a field is wholly different from ordinary matter, although it has been, to be sure, produced by matter, possibly a very long time ago. Its existence at present, however, is quite independent of the existence of matter.

The space between the stars is full of radiation which we call photons. These photons move around pretty much as mass particles. They have energy, of course, in that case, but they are not matter. Photons are light and they have no discernable effect except when they happen to collide with matter. Therefore it may be said that the origin of these photons as well as their destruction lies in matter, but the photons can and do exist, in fact forever, if there is no matter around. These fields are truly non-material which can have an independent existence apart from their effects on matter, by which we know them. We know

that photons exist because if they are absorbed on the retina of the eye we see light. This is the important difference between this kind of field, whose origin lies in matter but whose existence is independent of matter, and those other fields such as the electrostatic and magnetostatic which cannot exist dissociated from matter. Like other known fields, the electromagnetic must satisfy an appropriate law or set of laws known as Maxwell's Equations.

Next there is the metric field of the Relativity Theory. The properties of space appear to depend in a certain way upon the presence of masses. This is a very complex affair. One of the properties of space, for example, is that it is supposed to be curved. This invisible feature of space may not be the same at every point. The curvature of space simply means that a material particle or light wave which passes through it will not move in a straight line. All bodies which move through space will indeed be changed in their courses, according to the principles of the General Theory of Relativity. Such a metric field, as it is called, has for one of its consequences that it can transform or distort the shape of an object placed in it. A triangle removed to a great distance from the earth may no longer satisfy the axioms of Euclidian geometry. The sum of its interior angles may not add up to 180 degrees any longer. This occurs because the properties of space are different in different parts of space. Objects are distorted as they move through space because of the presence of a metric field, which is regulated by a law which was worked out by Einstein.

Then there are fields which are only probabilities. This does not mean that they are probably fields, but rather that the physical or mathematical quantity of probability forms a field. Since this is the most abstract field known to man at the present time, I shall not try to elucidate it beyond saying that probabilities also form a field of the scalar type and that the concept of the probability field is of extreme importance in quantum theory. Probability is also a function of position and possibly of time, and it too satisfies a definite law, called the Schrödinger Equation.

Having surveyed all possible kinds of fields—those which are material themselves, others which are associated with matter, and still others wholly independent of matter in their essence—we may ask what they have in common. The answer is, they all represent a continuous distribution of some quantity which needs to be further specified in each particular case. The field is a continuous distribution of something.

Methodologically, to make the term field meaningful we require two things: 1. There must be a way of defining the field quantity operationally. We can never escape the requirement of defining field quantities in an operational manner, in terms of some instrumental procedure. 2. Each of the quantities involved in a field must satisfy some law. Only when these two requirements are met does a scientist speak of a fully defined field.[1]

UP to this point we have been dealing in a rather precise way with some of the fields comprehended by physics. When we turn to biological concepts, the situation becomes very much more imprecise. From the point of view of science, this lack of precision has serious drawbacks, and if field theory in biology is to be appreciably advanced, some improvement in this respect is necessary. Let us illustrate what we mean by drawing upon the book previously mentioned by C. Judson Herrick, whose important pioneering work in the field of neuro-anatomy certainly qualifies him to speak on this subject. He says: "The word *field* has a wide variety of meanings, some static and some dynamic." (The field quantities which contain time as a factor he calls dynamic; those which do not change with time, he speaks of as static.) "In common usage and in this text, it may refer to an area with definable boundaries, to a specific topic of discourse, or to some sort of pattern or action, such as the field of a magnet or an electric charge. Field theories of the third class are now receiving a great deal of attention in mechanics, biology, psychology, and sociology."

Dr. Herrick next calls attention to a field that was introduced into the literature by two distinguished colleagues of mine, Mssrs. Burr and Northrop. He quotes from one of their articles: "The particle both conditions and is conditioned by its field." The background of this statement is as follows: Prof. Burr discovered the surprising fact that if a delicate voltmeter is placed near the skin of a growing organism, a potential difference between two points will appear. In other words, there is an electro-static field. He also indicated that this field is a function of the rapidity of growth; the field is weak except when the growth is rapid.[2] Dr. Burr further found that the strength of the field (represented by a vector) is in a direction in which the growth occurs. Therefore, he has hypothezed that every growing organism is surrounded by such a field which sustains the process of growth. The field is a concomitant of growth, and perhaps growth is a concomitant of the field.

In the article quoted by Judson Herrick, Burr and Northrop speak of the reciprocal relation between the field and the particles caught within it which are involved in the process of growing. This gives rise to the question: Is the field primary? Does it cause the particles to act as they do? Or, alternately, are the particles primary? Do they cause the field? If the latter were true, the discovery would not be particularly revolutionary, since it is known that the par-

[1] For more extended comments on the need of these two kinds of definition in all of science, see H. Margenau, *The Nature of Physical Reality*.

[2] The reader is referred to the article "Chaos or Configuration" by H. S. Burr, which appeared in MAIN CURRENTS, Vol. 11, No. 2, pp 31-34.

ticles and molecules of an organism carry charges and are certainly polar, and that when they move electrostatic fields are created. Therefore, if the field were merely a by-product of the motions of electrically charged particles, there would be no peculiar novelty in the Northrop-Burr conjecture. If, however, the field were actually primary, there would be a great deal of interest and novelty in the proposal. This would then lead to the further question: Where does the field come from? If it is not caused by the particles, how does it arise? The answer to this depends upon whether or not the field satisfies Maxwell's equation. If it does, then there is nothing new about it. If it does not, then it appears there is a wholly new feature in the process of growth. The Burr-Northrop essay states that "The particle both conditions and is conditioned by its field. . . . In short, any local system in part constitutes and in part is constituted in its behavior by nature as a whole . . . and the physical field in which it is embedded. . . . The reciprocal causal relation between field and particle amounts to a union of both viewpoints." In other words the presence of a field in biology is dependent upon and arises from the reciprocal relation between the field and the organism within it.

But the point may here be made that such reciprocity is not the true character of all fields, although it is typical of some. In the hydrodynamic field, for instance, it is true that the particles cause pressure and velocity of flow; the reverse is hardly true. Velocity and pressure are not the origin of the particles, nor are they the origin of the behavior of the particles because they indeed *are* the behavior of the particles. There is no reciprocity. In the case of the strain-stress field, again, there is no connection between the particles on the one hand and the stress and strain in terms of which the field is entirely defined, on the other. In the case of the density in the atmosphere, the situation is not much different. But when we come to the electrostatic and the magnetostatic fields, we find reciprocity. In the case of the electrostatic field, we have a field-producing body, a specifiable charged body, and another charged particle, so that the two repel or attract each other. We say, perhaps arbitrarily, that the first particle produces the field which then acts on the second, which is called the test particle. If the first particle is removed, the field disappears. Thus there is truth in the statement that reciprocity exists between the charged particle and the field.

In biological and psychological literature, this feature of reciprocity which makes for a kind of interplay between particles and a continuum is supposed to create the field. This is an interesting theory, and one hopes that in time it may develop a more adequate measure of clarity and precision.

Dr. Herrick's work has aroused in him an interest in what might be termed a psychoneural field. He says, "None of the field theories now current in physics or in psychology are adequate to explain the exact nature or the mechanical principles of psychoneural operations. Current discussions suggest to my mind that space and space-time treated relativistically may have properties far different from any that have so far been recognized in either Newtonian or quantum mechanics. In this I follow Einstein in his search for a unified field theory which will give a coherent picture of the universe as a whole. . . . These dynamic properties of space as a field of radiant energy may when adequately explored open a new approach to the mysteries of the mechanics of the body-mind relationships and perhaps also of the unexplained 'psi phenomena' recorded in the literature of telepathy and clairvoyance. Such speculations, of course, can have only heuristic value (if any) as suggestions for possibly fruitful lines of further research." (p. 267) This reference indicates a belief that any unified theory—whether Einstein's or one fashioned after Einstein—will explain psychophysical fields. Therefore, it is appropriate to consider what is meant by a unified field theory.

THE General Theory of Relativity attributes the attraction between material bodies, such as the motion of the stars, to the properties of space itself. Einstein succeeded in explaining away gravitational forces by altering the properties of space. To put it another way, the General Theory of Relativity denies the existence of forces altogether, and explains force in terms of the properties of space. To be sure, thus far it succeeds in doing this only for gravitation, which is the force between mass particles. There are at present three kinds of force known to science. There is first the gravitational force, second the force between electromagnetic objects, and third the force between so-called nucleons, the specifically nuclear force. Einstein and others have tried to make a General Theory of Relativity so embracing that it could accommodate the latter two kinds of forces as well, so that all dynamic interactions could be accounted for by the properties of space, although to date with incomplete success.

Unfortunately, the chances of doing this are not very great. When Einstein was developing the General Theory, there were only two kinds of forces known to physics, the gravitational and the electromagnetic. The third kind was discovered later in his life. Einstein did not succeed in providing a unified field theory which would even take care of gravitational and electromagnetic field forces, and the introduction of the third type makes the task still more difficult of achievement. Even if someone succeeds in unifying the three known types, it seems likely that by that time a fourth kind of force may well have been discovered. It is probable that discovery of new forces will always be one jump ahead of the unified field theory. However desirable success in computing the three known forces in a mathematically simple theory would be, we must yet realize that it would teach us very little about the psychophysical effects

Dr. Herrick and other biologists and psychologists are engaged in clarifying. The principles of psychoneural operations will probably be understood through reference to a specific area of research, rather than an appeal to a unified field theory of physics. Success will come from greater precision and penetration rather than through resort to greater generality.

The same might be said of two other fields which Dr. Herrick discusses: the biophysical and the cortical. While they present magnificent challenges to the investigator they require a clarification of terms, as Herrick himself foresees. Emphasis is to be placed upon the two inevitable conditions previously mentioned which make meaningful all the fields employed in physics: 1. an unambiguous operational definition of the field quantities that are being proposed and studied; and 2. a clear and preferably mathematical statement of the laws controlling the behavior of the field quantities.

If I now turn to the larger literature of biology that deals with fields, I often get the impression that "field" is a term behind which can hide a great deal of loose thinking. To be sure, the field is a concept which may indeed hold as much promise for the life sciences as it has had for the physical sciences. But at present it often represents, I am afraid, an excuse for analogical reasoning. If a picturesque way of presenting certain problems is wanted, the field lends itself nicely to that purpose. Under those circumstances, allusion to fields is a manner of posing a problem, rather than of solving one. Something more rigorous is wanted to make field theory in biology really fruitful.

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NEO-DARWINISM AND ORTHOGENESIS

Alfred Taylor

Two Prevailing Views of Evolution Compared

IN this modern age, humanity is influenced by science in two direction. First, there are the laboratory data, the basis for the mechanization which has become such a marked characteristic of present-day living. The deepening effect of this aspect of science is evident in many directions in the lives of all of us. But perhaps of even greater importance is the influence that science has on our minds through concepts, theories and assumptions which have become dominant in the thinking and understanding of the scientist.

The training and experience of a scientific investigator is such that he learns to conform to certain standards of thought in his approach to the phenomenal world. He has the problem of obtaining data, of setting up theories which relate and give meaning to these data and of using a terminology which will facilitate accurate communication with his contemporaries. He learns to depend on physical manifestations for his facts and, in reasoning and theorizing, to utilize the simplest explanation of observed phenomena. The scientific approach to knowledge of the world, as we all know, has been most successful. Hence, the scientist has confidence in the way he looks at the world and in the data he obtains. As far as scientists as a group are concerned, theoretical manipulations are valued on the basis of their productivity in sparking more research and the accumulation of more data. Theories are vigorously defended and upheld as long as they serve their purpose, but are cast aside as they become untenable.

The great majority of scientific theories and assumptions has little or no relation to the thinking of nonscientific people. Very few attract any attention beyond the fields to which they apply. But some scientific concepts appear to undermine the validity of ideas which are generally accepted in our society.

One source of repercussion between the scientific way of viewing the world and other areas of human thought and activity has resulted from the comparatively recent change-over from religious to scientific dominance in many fields of human interest. Western minds were jarred and the reigning arbiters of thought were dismayed when the concept that the Earth was the center of the Universe was found to be untenable. The victory for science in this instance virtually assured the eclipse of many of the prevailing dogmas as far as thinking people were concerned. Since that time, science has moved ahead with growing rapidity and many aspects of the world assumed to be in the province of religion have become subjects for experimental investigation. Even the origin of man himself came within the scope of science, and when Darwin in 1859 advanced the concept of evolution, the impact of his ideas aroused and disturbed the western world at all levels. The idea of evolution appeared to invalidate Christian teachings and a certain proportion of Christians still refuses to recognize Darwin's or anybody else's evolution as applied to humanity. But Darwin, it will be recalled, did not just introduce the concept of organic evolution. He proposed an hypothesis based on careful and patient studies which attempted to explain how animals, including man, have evolved from simpler, more primitive ancestors of the past. This concept assumes that living organisms are constantly varying, and that the environment serves to screen out animals which have varied to their disadvantage and to preserve those which have been improved. So, evolution proceeds by the innate tendency for organisms to vary in all directions plus the principle of natural selection which insures the survival of the fittest.

As the full implication of this theory began to be understood, it had a deadening and discouraging influence on the human spirit. Many people had deserted the prevailing expression of Christianity because of its discredited dogmas and had turned to science as the brilliant new star on the horizon of man's search for the truth. But the theory of evolution, which gradually gained the support of scientists everywhere, appeared to make of man himself a creature evolved through blind chance, the product of the random play of automatic mechanization.

Since Darwin's time, advances in the biological sciences have been interpreted as further confirmation of Darwin's original thesis so that today the overwhelming majority of biologists accepts the theory with the additions which have come about through the advances in our knowledge of heredity or genetics. The theory in its present form is usually designated as Neo-Darwinism.

THE prevailing theory of evolution is basically very simple. In the germ cells of living organisms, there are hypothetical entities known as genes which are

assumed to control bodily growth and characteristics. The genes in a germ cell, destined to develop into a man, determine not only the fact that a man will emerge from the development of this cell but also the way he compares with and differs from other human beings. The data of genetics indicate that these genes undergo certain changes from time to time which are termed mutations, and these mutations which are constantly arising in the germ cells of an animal population result in individual differences in physical make-up. So that over a period of time there are constant differences arising which can affect every aspect of an animal.

On the other hand, the environment serves as a limiting factor in the growth of a population. It is well-known that the breeding capacity, or biotic potential, of all types of animals overruns the food resources of the environment, and in addition such factors as disease, predators, climatic conditions, etc., all tend to take their toll of an animal group. Hence the natural sequence is that only a fraction of an animal generation survives to produce offspring. Those animals best fitted to survive tend to do so. This is the principle of natural selection.

The Neo-Darwinian concept considers, then, that evolution proceeds because animals vary in all directions as a result of gene mutation in the germ cells, and those variations which assist the animal in its struggle for existence favor its survival. With this principle effective over the unthinkable period of time living organisms are known to have occupied the earth, it is assumed to account for the presence in the world today of the vast assemblage of living beings with all their diversities of form and habitat.

There is one other consideration which needs to be mentioned before we can fully appreciate the Neo-Darwinian concept of evolution. The gene changes, or mutations, which constitute the basic phenomena from which evolution proceeds, are assumed to occur at random. To quote the late Richard B. Goldschmidt, an eminent geneticist, "Mutations occur by chance and completely haphazardly without any relation to the environment." It becomes evident then that Neo-Darwinian evolution proceeds by the interaction of randomly produced gene mutations and the environment. The lowliest worm and a human being have this much in common: they are both products of an automatically functioning game of chance.

Naturally in such a brief resume of a theory which has become so dominant in scientific thought, some of the accessories have been ignored, but what has been said includes the core and the essence of the concept.

There are data, especially in the field of paleontology and embryology, which some have considered to be refractory to the Neo-Darwinian assumptions, and this has led a few scientists to propose modifications which eliminate the idea of randomness in germinal mutation. It is obvious that Darwin's thesis can be applied to evolution with or without the mechanistic feature. The critical point is how the germinal changes arise. If we think of them as the product of chance, then evolution is a purely mechanistic process, but if we consider mutations to result as part of an unfolding of certain latent capacities, then we have an altogether different situation. The principle of natural selection continues to be operative, but with different emphasis, with either viewpoint.

THE only one of the theories proposed as an alternative to the prevailing concept that needs concern us here is the one designated as orthogenesis. It postulates that, instead of gene mutation being a random process, it proceeds in an orderly fashion disclosing potentialities inherent in living material. In the germ cells of the primitive ancestors of modern animals there was the capacity to evolve into the present forms. Evolution becomes a matter of unfolding or revealing that which was latent in the beginning. The idea is exemplified in what happens when a germ cell develops into a particular animal. The fertilized ovum contains the potentiality for forming the completed animal, and in giving expression to this capacity, does not proceed at random but goes through a carefully integrated series of steps which include multibillion structures and activities all synchronized with the precision necessary to develop the wonderful complexity of a living body. Evolution, according to this orthogenetic viewpoint, consists of a comparable series of steps which bring about, not a single individual, but the evolvement of a phylum with all its branches and subdivisions.

In the August and November 1958 issues of *The British Journal of the Philosophy of Science,* there are the first and second parts of a paper entitled, "Two Evolutionary Theories," written by Marjorie Grene of the University of Leeds. The article contains an analysis from a philosophical point of view of the two opposing theories of evolution which we have been considering. She begins her paper by saying, "1959 will find the majority of Western biologists assenting with renewed enthusiasm to the basic principles enumerated a century ago in *The Origin of Species.* But there continues to be an heretical minority, and, moreover, the heretics speak with authority and vigor." Professor Grene has taken for her appraisal the majority view of evolution, Neo-Darwinism as expounded by a distinguished American paleontologist, G. G. Simpson, in contrast with a minority view of the subject, orthogenesis, which is upheld and defended by an equally distinguished German paleontologist, O. H. Schindewolf. Each of these men is the author of a book and other writings devoted to their views on evolution. Further, they have sharply criticized each other's stand on this subject.

The first part is mainly concerned with outlining the respective positions of the two scientists with regard to the problem of evolution. Professor Simpson "sees evolution as a continuous series of minute

changes in innumerable directions, in which all alterations of any significance, larger as well as smaller, quicker as well as slower, are determined by the great co-operating 'pressures' of mutation, geographical isolation, and selection, with adaptation as the universal effect, and criterion, of systematic change. The basic concept, ultimately, is variation in the occurrence of genes; out of such variations all the systematic relations of living things have been gradually evolved." Implicit in this theory also is the idea that small changes in animals gradually build up to bring about the wide divergences observed between living organisms.

Schindewolf considers that evolution proceeds through large variations which establish a particular animal type and then exhausts the possibilities of the type by a process of orthogenetic development which involves small mutational changes. His viewpoint retains natural selection but only for the minor task of evolution within an established design.

Grene brings out the fact that while the two theories are mutually incompatible, yet Simpson and Schindewolf base their theories on the same data. The difference arises in the way each interprets these data. Neo-Darwinism, as upheld by Simpson, postulates the summation of small changes in the germ plasm over a long period of time as sufficient to account for the great diversity of present day animal forms. Schindewolf, in accordance with orthogenesis, states *"that life can originate novelty."* He admits the charge that this capacity in living matter is mysterious, but no more mysterious, he believes, than physical concepts, such as force or gravitation, and not nearly so mysterious as the assumptions implicit in the idea of natural selection as it is used in Neo-Darwinism.

One of the fundamental differences between the two theories, it is pointed out, lies in the different use of the structural aspect of living forms. The Neo-Darwinian theory emphasizes the conditions which give rise to structure but ignores the structural organization of the individual or species. The important thing is gene mutation and its reaction with the environment through the animals which bear them. The continuity of living forms, which this theory emphasizes, is in the germ plasm and not in the transitory forms which develop from it in each generation. So evolution becomes a matter of Mendelian statistics which record a continuous process of evolutionary change. Grene notes that this concept of evolution has received much attention from very many capable minds, and it "is indeed a brilliant perpetuation of Darwin's vision, and its persuasive force is compelling."

On the other hand, the viewpoint defended by Schindewolf is simpler. His theory relies on mutation as the originating mechanism of new types but the "adaptative control of mutation occurs only within, not between types. The basic pattern is of change from type to type, and always, with the more general appearing before its specialized subdivisions."

IN the second installment of her article, Grene attempts to assay the relative merits of the two theories. She says "we may seek to lose ourselves in what Simpson describes as 'great groups of animals living their history in nature.' Or we may look rather at the ascending level of organization into which the continuous stream of protoplasm has shaped itself."

Continuing her analysis the author considers, "First, we should acknowledge the continuity of life. . . . Secondly, . . . new principles of organization appear to have arisen out of conditions that in themselves stretch back continuously. . . . This duality, whatever the difficulties of stating it precisely, is essential in some form to any adequate assessment of the achievements in evolution." But she points out that in the modern mind there is a passion for concepts which involve "the reduction of principles to the least possible number, the love of explanation in terms of the least denominator, of parts rather than wholes, conditions rather than reasons. . . . In fact, it is from this very reductivism that Darwinism has, in large part, derived its convincing power. For what it provided, and provides, is an explanation of evolution in terms of the mechanistic tradition of explanation. A mechanistic explanation must be both *logically simple* and *automatic*. Darwinism satisfies both these demands." The theory is simple, the analysis continues, since it unites all the phenomena of evolution in one hypothesis and it is automatic since it conceives organisms mechanistically and their evolution as resulting from the interaction of automatic conditions which require no outside control. In contrast to this, orthogenesis denies that evolution can occur automatically through the reaction of random gene mutations and environment but postulates a third factor, an inner directive potential in organisms which is the real basis for the evolutionary process. This third factor is contrary, according to the Neo-Darwinist, to the principle of mechanism and therefore has no place in science. Actually in practice, the Neo-Darwinists are not able to keep strictly to the mechanistic level but introduce such ideas as type and organization surreptitiously while at the same time appearing to be unconscious of their use in this manner.

"I suggest . . . that instead of Occam's razor we might adopt as a test of theories of evolution the opposite principle: that . . . aspects of reality . . . should not be *subtracted* beyond what is honest. In the light of this principle, we should ask of any theory of evolution, does it pretend to do without concepts which in fact it does not do without?"

An evolutionary theory, Grene considers, should account for the origin of new forms of life. But new forms of life embody new operational principles and these must be recognized as such before we can take into account the conditions out of which they arose even though such conditions were necessary for their development. It is on the basis of such considerations that Grene comes to the conclusion that of the two theories of evolution, Neo-Darwinism and ortho-

genesis, the orthogenetic concept as put forth by Schindewolf more adequately accounts for organic evolution.

One important aspect of Professor Grene's analysis of the two theories lies in the fact that it demonstrates that among biologists of equal distinction, basing their ideas on the same data, there can be radically different viewpoints on this important matter of how evolution works. But more than that she has called attention to the absurdities which arise when an attempt is made to force living matter into purely automatic mechanical categories which succeed only in driving life out of the picture.

The prevailing concepts of evolution have permeated the mind and spirit of the western world with the chill atmosphere of materialism and randomization. This has come about not so much on account of the merits of modern Darwinism, but because it tends to carry with it the prestige of science. The spectacular effects of scientific achievement have awed our minds into uncritical acceptance of that which otherwise would have been viewed in its proper perspective.

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SOURCE READINGS: INTEGRATIVE MATERIALS AND METHODS

Hypnosis as an Interpersonal Relationship

IN a series of papers which have appeared in *The Journal of Psychology* in 1957 and 1958, Dr. Theodore X. Barber of the Laboratory of Social Relations, Harvard University, has discussed the phenomenon of hypnosis and the necessity for clarifying its conceptualization. So long as hypnosis is viewed as "trance," as a "state of dissociation," as an "unconscious level of awareness," as the result of "suggestion," or as a "preconscious" or "subconscious" state, Dr. Barber feels that it will remain an unexplained phenomenon. In his view, hypnosis is not a state of any kind; the term is rather a descriptive abstraction referring to a number of overlapping processes relating to a transaction between subject and operator.

The phenomena of hypnosis can be explained by one general principle: the behavior of the hypnotic subject is a direct function of his altered perception of himself and of the situation. When a surgical operation is performed with hypnotic anesthesia, the subject is convinced that he cannot feel pain, i.e., he perceives his arm or leg as insensitive to pain; when the subject has amnesia for the hypnosis, he perceives himself as unable to remember; when he is deaf to sound stimuli, he really believes that he is unable to hear anything. The evidence indicates the phenomena of hypnosis can be explained by the principle that the behavior of the subject is a function of the way he construes the situation. Experiments in hypnotic induction of anti-social behavior show that a good hypnotic subject can be induced to commit anti-social or dangerous acts if his perceptions and conceptions are altered in such a way that he believes the behavior is normal and proper, and accepts the suggestions as literally true. For example, a subject can be induced to steal another's purse if the operator structures the situation so that the subject believes that the purse is really his own. Again, in age-regression, if a subject is convinced that he is six years old, his behavior is in accordance with his perception of himself as a six-year-old.

Summarizing the evidence, Barber states that, if

the hypnotist is taken as the frame of reference, the transaction between subject and operator can be briefly conceptualized as follows: by speaking chosen words, by careful timing and by skillfully manipulating the situation, the operator attempts to guide the subject (a) to become motivated to carry out instructions, (b) to become relatively unconcerned about all aspects of his self and his surroundings except those to which his attention is specifically directed, and (c) to believe that the hypnosis can "make him" experience unusual things. These goals are interrelated with, and are means toward, the final and most important goal: to guide the subject to the point where he (d) accepts the suggestions as literally true statements.

The operator can alter the good subject's perception of reality because of two interrelated processes: (a) the subject is detached, unconcerned, and away from the normal reality-stimuli; he is in trance, and (b) he is ready, willing and expecting—he is "set"—to perceive the operator's statements as valid descriptions of what is or is not occurring.

A number of experiments indicate that both of these processes are necessary aspects of hypnosis. Eysenck and Rees, for example, found that if a subject is not "initially suggestible," a drug, e.g. nitrous oxide or sodium amytal, cannot by itself induce hypnosis. However, if the subject is "set" to follow instructions, narcosis helps the induction of hypnosis by aiding him to become and remain detached from intruding reality-stimuli.

If there is any characteristic that good hypnotic subjects have in common, according to Barber, it is that they have had, long before being formally hypnotized, the habit of becoming relatively detached and unconcerned about surroundings; they were all apt to fall into abstractions or reveries, or were able to concentrate on their work by "blocking out" environmental stimuli. With rare exceptions they could also go to sleep easily and quickly at any time or place. This process of relative detachment from the environment is often conceptualized as "trance." There is no objection to the use of this term *if* it is remembered that it is not an entity and that it is not unusual, but rather a not uncommon aspect of daily life.

With regard to the presence of the second factor, willingness, it seems that the hypnotic subject does not remain relatively detached from his surroundings if he is not "set." This factor of readiness and willingness has been emphasized in the recent theoretical formulations of White and Sarbin, in which, under the more general concept of "motivation" they see the hypnotic subject as "striving to behave like a hypnotized person as this is continuously defined by the operator and understood by the subject."

However, Barber feels that motivation and relative detachment are not in themselves sufficient conditions for hypnosis. An individual is not "deeply hypnotized" unless he also believes that the operator's words are true statements. Evidence shows that a good subject quickly becomes a poor one when he realizes that the hypnotist does not have any special power or ability to make him believe anything he does not wish to believe. When this third factor of belief in the operator's ability is added to detachment and a "set" attitude, the subject is ready to experience all the hypnotic phenonema—analgesia, hallucinations, amnesia, age-regression, etc.—because he is ready to accept the operator's words as valid statements about himself and his surroundings, and to perceive and conceive reality as the operator defines it.

Dr. Barber concludes his discussion of "The Concept of Hypnosis" with the following statement: "Hypnosis is not a 'state of consciousness.' Hypnosis is not a 'thing' or an 'entity.' Hypnosis is not something which 'makes' a person behave in unusual ways. Hypnosis is a descriptive abstraction referring to an interpersonal relationship which is characterized by a number of overlapping processes. . . .

"When the subject is concerned only with the words of the hypnotist and when he literally believes that the hypnotist's words are true statements, he experiences many or all of the hypnotic phenomena. . . . The psychology of hypnosis is therefore one aspect of the psychology of 'belief' or 'perception.' The subject behaves in 'unusual' ways only when the interacting and overlapping processes between the subject and the hypnotist are effective in altering the subject's 'perceptions' and interpretations of himself and his surroundings."

—E. B. Sellon

Lest Thinker Be Submerged by Producer

"EARLY in his school experience a child develops his own characteristic approach or strategy in learning new material, which in turn utilizes certain basic skills of thought. The approach to learning which evolves is vital in determining not only the child's success in school but more important, the real value he will receive from his education."

The quotation above is taken from an article in *Shady Hill News* entitled, "Learning Strategy and the Skills of Thought" by William P. Hull, a teacher at Shady Hill School in Cambridge, Mass. In this article Hull considers the various motivations in the child's approach to learning, and discusses their effects on the resulting learning strategies, and the child's orientation to problem-solving. The value of standardized "objective" tests in rating a particular child's ability and predicting his future success is considered in terms of these various motivations.

The range of motivations is wide, producing a graded spectrum of satisfactions or dissatisfactions in the learning situation, which tend to impose specific structure, not merely upon the emerging learning skills and strategies, but more importantly upon the child's

attitudes toward problem-solving, which have so important a bearing on the developing personality and its relationships.

Hull splits the motivational spectrum into two categories which are labeled "the Producer" and "the Thinker," describing them in terms of orientation, response to pressures, and differences of learning strategies and related skills of thought. Such classification is admittedly oversimplified, yet it provides some insights on the general problem.

"Students who rely heavily on their memories . . . and who are reluctant to abandon their original action, although it is, temporarily at least, unprofitable, we have called Producers," writes Hull. "A Producer is oriented towards meeting other people's requirements. He is very interested in being successful and therefore ready to take on any new work, particularly if it is planned for him in some detail. The essence of his strategy is to achieve speed and thereby the signs of success by avoiding the roundabout behavior which thinking requires. . . . A typical Producer allows himself little time for reflection; his thinking is so fast that it goes in a straight line without relating to other experiences. . . . A Producer with good verbal skills may learn to supply a number of possible solutions to a problem but then be unable to judge the relative significance of what he has said."

One example of this type of orientation concerns a girl in a fifth grade music class who was unable to name the second space on the musical staff. She knew the names of the lines, but couldn't remember the names of the spaces. "She knew they spelled something but couldn't remember what. She was so intent on finding the code word which would give her the answer that she could not accept the teacher's suggestion that there was another way to figure it out. . . . She was unable to use this information because she was relying on a strategy which had proved successful in the past, i.e., find a single path to an acceptable answer and then stick with it.

"We can contrast this strategy with that of the Thinker who is usually under much less pressure for achievement than is the Producer, or at least is not motivated in quite the same direction. He shows more independence than the Producer. . . . Because he is oriented to the intrinsic nature of the problem, rather than to external clues, he may be slower in responding to a question than the Producer, but he is able to suspend his judgment when necessary, go back over his thinking if he finds himself in error, and frequently comes up with original ideas. His delight is in ideas and he responds to situations where problems can be dealt with flexibly. . . ."

The Thinker is willing to consider alternatives, and to puzzle out things which he does not immediately grasp. His real strength lies in his sense of relevance and his ability to draw from past experience or his imagination ideas which bear on the present problem. Unlike the Producer, he does not rely heavily upon his memory, but has his experiences sorted in such a fashion that they are readily available to him. The actual process, as well as the result, of working on a problem is enjoyable to him.

Hull warns us repeatedly against a too-rigorous application of these labels to any specific child. Since these strategies are very sensitive to pressures of motivation, a child may shift his approach in response to the atmosphere of a class. Thus in free discussion (with no pre-determined "goal") a child may be able to use all the flexibility and spontaneity of a creative Thinker. The same child facing a written assignment (where a high mark spells success) will exhibit all the drive and blind energy of a Producer. Sometimes children can learn to use both strategies, modifying their approach as the occasion demands.

The fact remains, nevertheless, that children who are poor achievers as measured by standardized tests as well as by teachers' evaluations, are often remarkably able in problem-solving situations; and conversely, that children who can complete assignments quickly and efficiently are often at a loss when dealing with problems where specific instruction has not been given. Hull recognizes that standardized, "objective" tests are loaded in favor of Producers, and says in addition:

"While the Producer's approach succeeds in most school-type activities, including such tests, the Thinker is left with few advocates and is becoming increasingly difficult to defend. Even well conceived programs of education, especially if they are ambitious, favor the Producer over the Thinker and the unbalance increases with mounting pressures for achievement." Yet the world has need of the Thinkers who can go beyond what is already known and solve the many new problems which are arising in a rapidly changing society.

This presents a dilemma to the conscientious teacher. Curricula abound in tests which call forth Producer-type skills. The more reflective abilities and wider conceptual grasp of the Thinker as well as his skills of mental mobility and flexibility of attitude must be nurtured; these are the tools for further expansions and explorations, paving the way for the emergence of Thinker-type creativity. The Thinker does not come into his own until creative work is called for—often not until he has finished his formal schooling, perhaps not until he has found his life's work. He must not be permitted to seem an educational misfit unless he can learn some Producer-type skill.

In summary, Hull observes: "This is a complex and somewhat paradoxical situation. Teaching is still an art and it is no more easy or desirable to control the individual artist than it ever was. We are approaching the point, however, where we must be guided in our artistry by a deeper understanding of our students' thinking, their strategies of learning and the skills of thought upon which these strategies are based."

—Alan Mannion

NEWS AND NOTES

RESPONSIBLE people in all countries are so harried by immediate problems that they seem to tend to make decisions on very short-range considerations, even simple expediency. These over-simplifications mostly create more problems. Policy must have a basis in principle as well as in facts. If we are to have peaceful world settlement something much more fundamental than the claims of two or three kinds of capitalism and attendent political practices must be considered. The alternative to competent thought is death, destruction, and entire dislocation of the world structure.

That the crisis is at the very least nothing less than a vast liquidation of forces operating on an historical scale, everyone will concede. Working upward on the time scale we first see what might be called karma, on the scale of nations, at work. The chain of Moslem states, stretching from western China to the Atlas Mountains, has been severed by the establishment of Israel under the protection of nations professing Christian doctrines. In our day, thus, we have seen the fall of the Temple, the dispersion, corrected. Notice the scale: Here we witness the outcome of events which go back 700 (Islam), 2000 (Christian), and more years in the case of the Jews.

Much larger on the time and the geographical scale is the spread of Indo-European peoples. For many millenia this great lingual and originally united racial group has been moving from its homeland out over the world into Iran, India, Ceylon, Southeast Asia, into Europe, the Americas and elsewhere. With the end of colonialism a sub-movement of dominance by force has now been completely arrested; but the evolution of a world society developing on this Indo-European nexus continues, and the current crisis is a feature of this vast process. Students of current events who think mostly in such terms as immiscible mixtures of oil and idealism, or of serums and sermons, tend to discount historical forces because they see no pattern of purpose in human evolution. They so much over-shorten the perspective that, in my opinion, they inevitably lead the world on from crisis to crisis.

But for our present purposes this failure to read history does not too much matter, for the true dimensions of the crisis far exceed history and even pre-history. Man has become a force on a *geological* scale of magnitude. He is poisoning the atmosphere and the globe with fall-out from above while he liberates noxious gases in the crowded canyons of his monstrously large cities. He is changing the courses of rivers and making drafts which lower the water tables everywhere. He has destroyed growing cover and dumped topsoil into rivers. He draws the oils from the deep sands and disorders symbiotic systems of continents.

The issues therefore are basically this: Why did geological process produce man at all? What really does nature intend him to be? What *is* man?

These questions almost never come up in a serious sense. There seems almost to be a conspiracy of silence. Not only do we seem to have settled into the belief that no one knows the answers; it seems to be assumed that they can never be known, because there is no meaning for man.

Apparently the failure of philosophy to keep mechanism and materialism in their proper place in the nineteenth century has so thoroughly numbed our minds that we are still not awakened to the fact that the very science which, as ungoverned and unplanned technology, wears the visage of destruction, contains the beginnings of a philosophy—and a metaphysics—of nature which, rightly used, will lead to human self-understanding.

Therefore research into materials for a better philosophy of nature is our paramount need.

In the United States there are many resources which could be devoted to such research. But in the West the climate of inherited thought is unfavorable to the making of a start, it seems. In the East—in Ceylon, for example—it should be easier to conduct such studies. The cosmology and the scientific standards of the Buddhist and the Hindu traditions are incomparably high. By means of direct insight and the added force of reason, titans such as the Buddha and Shankaracharya were able to look into the nature of things. Today that wise ancient science is being confirmed by quantum mechanics, the biology of genetics, human psychology and the like in hundreds of particulars, at present hidden in technical terms, uncoordinated, and little understood except operationally.

Without in any way impeding research or imposing doctrinaire systems upon free inquiry, a country like Ceylon could start an institute for integrative studies which would soon prompt like labors elsewhere. As the work would stand upon publicly demonstrable facts and principles—genetic and morphological orders, the quantized radiation field, the space-time potential, the reality of the non-material—there could be no rejection anywhere, but instead a consensus won amid the utmost freedom. The whole world needs this, so that the impending universal literacy and security shall not mean universal sensate pursuits and mere degradation. Restoring the feeling of mankind's essential unity, such studies would tend toward the ignoring of differences, the recognition of human brotherhood. They would restore the search, and kindle the hope of making life meaningful—no longer a brief, bewildered period, a tale told by an idiot "full of sound and fury, signifying nothing."

—*F. L. Kunz*

REVIEWS

Sounding the Deeps of Modern Man

ALLEN WHEELIS, psychiatrist and psychoanalyst practising in San Francisco in his first book, *The Quest for Identity* (W. W. Norton & Co., 1958, $3.95, 250 pages) presents an interesting and original point of view concerning the place of psychoanalysis in our times. His discussion is interspersed with vividly written episodes of personal narrative which illustrate his points and add human interest as compellingly as any novel.

Wheelis characterizes today's society as one without commitment to ideals, without values strong enough to die for, without a sense of direction. The result is an immense restlessness and rootlessness and a loss of a sense of identity. "To commit allegiance and will and energy to valued ends means to define the self in terms of these ends and to find in them the enduring meaning and purpose of life. The social character of our time, being largely without goals, lacks this sense of meaning and purpose. This lack is experienced as futility, emptiness, and longing."

Fifty years ago, people lived securely in their home communities with a definite, unquestioned set of mores and values. There was no uncertainty. But in our times, increased exposure to alien mores has caused the present generation to view mores and values as relative rather than absolute. The sway of religion has diminished, as has the authority of the father. Consequently, as the author puts it, "apart from changes in the content of moral behavior, there have been changes in the source of morality, the mode of conformity to moral directives, and the site of moral authority."

According to Wheelis, we lost God and the eternal verities before we were ready to live in an unprotected universe. The feelings of rightness and wrongness are no longer attached to stable institutions—the church, the party—and therefore create restlessness, yearning, and discontent. These in turn have made possible the luxuriant blossoming of psychoanalysis in the twentieth century.

However, according to the author, a sense of identity cannot be found in psychoanalysis, and those who seek their "true selves" in analysis are misguided. Analysis "could uncover an identity provided such were hidden, but it cannot create one that is lacking. It could expose a pattern of values, a philosophy of life, provided such were repressed; but these things are not likely to be found in the unconscious."

Because of our immense advances in technology and our stress upon the instrumental process, instrumental values are undermining the institutional, including direction-giving philosophies and religions. The instrumental process does not provide clear-cut answers to life decisions as does the institutional. As institutional values are undermined, the individual no longer finds meaning in society; he becomes himself the referrent of meaning and value. However, in contradiction to the pessimism of the existentialists, the author holds that an instrumental society has meaning in its continuing growth and progress—in its direction away from ignorance, superstition, cruelty and helplessness. And "individual life has value and meaning by virtue of its participation in this process."

Dr. Wheelis is to be admired for his fresh insight into the deeps of modern man and for his optimism in the fact of the difficulties pointed out by his analysis of the modern plight. However, he stops a few steps short in his solution, it would seem. He apparently sees an overall, direction-giving philosophy possible only through traditional and institutional patterns, unscientific and based on blind belief. He has not caught the vision of a broad philosophy emerging from empirical evidence and the instrumental process itself, supporting values and imparting a sense of direction for the individual. True, instrumental knowledge does change ceaselessly, which might discourage a search for lasting values based on it. However, as Wheelis himself intimates, the principles uncovered by such knowledge do not change so readily. Philosophies of science are not overthrown by each new discovery, but they seem to have strains embedded in truths which do not change. When we are able to develop a philosophy based on the surest and most reliable of human knowledge, then perhaps man's sense of identity can be restored on a firmer foundation than ever before.

—S. J. Nicholson

How We Learn to Know

FOR quite some time it has been this reviewer's contention that the most basic of all research projects is a deeper and more detailed study of the cognitive process. This is true, it seems, because what we so glibly term learning, teaching, and education are essentially empirical experiences and are not yet illuminated and supported by truly scientific fundamentals which are (or should be) available to appropriate research. Since the days of Ur of the Chaldees we have assumed that education occurs by exposing a learner to a teacher under certain formal circumstances. This is supported by the fact that all of us have learned more or less by experience with the givens in our physical and social environments. We have precious little knowledge as yet as to *how* the mind and the nervous system are capable of learning or what they need in order to learn.

So we greet a new volume which makes a material contribution, in our opinion, to what we have termed basic research in the cognitive process: *The Growth of Logical Thinking from Childhood to Adolescence,* by Bärbell Inhelder and Jean Piaget (Translated by Anna Parsons and Stanley Milgram, N. Y., Basic Books, 1958, xxiv + 356 pp, index, $6.75).

With his collaborator, Piaget, who is known for his more than a score of books, presents an elaborate and carefully documented study of the ways of thinking in some 1500 boys and girls. These studies of individual children have been creatively and skillfully developed.

The empirical researches of Buhler, Gessell, and others have well established the existence of the time scale in maturation—neurologically and mentally. This is an extension of the phylogenetic and ontogonetic development which is manifest during the period of gestation.

As a result of the earlier work of Piaget, four major stages of post-natal growth can be delineated.

The present volume deals more particularly with the transition from the third stage to the fourth and final phase which takes place between twelve and fifteen years ". . . and involves the appearance of *formal* as opposed to *concrete* operations. . . . Its most important features are the development of the ability to use hypothetical reasoning based on a logic of all possible combinations and to perform controlled experimentation."

The work is technical but it is extremely important. Each of the first fifteen chapters include a very enlightening experimental part by Mlle. Inhelder and a brief analysis of Piaget. Piaget gives us two very profound chapters on (a) Formal Thought from the Equilibrium Standpoint, and (b) Concrete and Formal Structures. These are replete with the symbolisms of mathematical logic but their importance as ". . . an attempt to isolate and describe *mental structures* on which reasoning processes are based . . ." cannot be overestimated. It is only in such materials that insights can be gotten for the "break through" into new understanding. If we are ever to revolutionize educational theory and methods, we must gird up our loins and master such works.

—Harvey W. Culp

A Social Study of the Parochial School

A definitive and apparently comprehensive study of the parochial Catholic school has been written by Professor Joseph H. Fichter, S. J. Loyola University of the South: *Parochial School* (University of Notre Dame Press, 1958, 471 pages and index, $6). It is part of a scheme reporting upon "formal and informal patterns of religious behavior centering around the parish church," "parochial societies of lay persons," this study, and "the family life of parishioners." The long-suffering reader of dust-dry social studies should be warned that this book is not to be sneezed at. The writer is no stuffed cassock, as may be seen at once from a glance at his photograph (on the jacket) and confirmed by items like this subtitle in Chapter 3: "The Big Shots." We quote, so that the writer's style, his wonderful spirit of participation, may be gauged directly:

"The eighth grade appears to be the most enjoyable year for both boys and girls at St. Luke's school. 'This is my big year,' wrote one boy, 'the tops in school, the year everybody is waiting for.' The boys and girls of the honor patrol, chosen because of leadership qualities and academic achievement, feel very important in the performance of their duties. The girls operate a kind of snack bar at recess, supervise the younger children at lunch time in the classrooms, the cafeteria and on the corridors. The boys take turns selling milk to the children after Mass, and bring small cartons of milk around to the classrooms just before the noon period at eleven-twenty. These and other chores are sought after by the eighth graders, who demonstrate their sense of responsibility in performing them."

This study is directed into a Catholic school (St. Luke's) and a public school (William Howard Taft) and therefore has high value indeed for Catholic and non-Catholic readers alike. What the author has to say about "the pressure of conformity on the teacher" and the resultant "pressure on the pupils" (pp. 405-406) in the parochial and the public situations is most revealing.

An admirable report, this, which raises anew the one question seldom asked, and not yet answered: When do we increase the unity of purpose and the sharing of understanding in our entire school system by making richly available in lay terms all that wealth of insight which is buried and largely neglected in a myriad studies of nature science has so long pursued? One great problem in this country is that we know *in common* far too little of that which really counts for unity of purpose about things of the spirit. *Parochial School* is a social, not a curriculum, study. Anyhow, St. Luke's is an elementary school, so except as regards religious instruction, the book tells us little as to the classroom treatment of subjects. A comparable study of Catholic and non-Catholic treatment of educational content would show, one suspects, about an equal neglect of meaningfulness and an equal acceptance of disjointedness in the curriculum.

—F. L. Kunz

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